# NexusConnect
# Component Library

Professional HVAC/BMS Design Components

202 Components: 95 2D SVG + 107 3D GLB

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# Table of Contents

# 1. Introduction

The NexusConnect Component Library provides a comprehensive set of 2D and 3D components for building professional HVAC and BMS floor plan designs. All components feature:

• **Connection Points** - Standardized connection points for seamless component joining

• **Realistic Materials** - PBR materials for photorealistic 3D rendering

• **Resizable Design** - Components can be scaled in the NexusConnect editor

• **Cross-Platform** - SVG for 2D, GLB/glTF for 3D compatibility

## *Library Statistics*

| Category | 2D (SVG) | 3D (GLB) |
|---|---|---|
| Structure | 10 | 11 |
| Ductwork | 18 | 18 |
| Piping | 7 | 11 |
| Valves | 13 | 14 |
| Equipment | 18 | 19 |
| Sensors | 15 | 13 |
| Rooms | 14 | 21 |
| **Total** | **95** | **107** |

# 2. Structure Components

| Component ID | Name | Description |
|---|---|---|
| wall_straight | Wall Segment | Standard wall with connection points at both ends |
| wall_corner_90 | 90° Corner | 90-degree corner wall piece |
| wall_corner_45 | 45° Corner | 45-degree corner wall piece |
| door_frame | Door Frame | Standard door frame with jambs and header |
| door_single | Single Door | Single-panel door with handle |
| window | Window | Window with frame and glazing |
| stairs | Staircase | Multi-step staircase with connections |
| elevator | Elevator Shaft | Multi-floor elevator shaft enclosure |

# 3. Ductwork Components

| Component ID | Name | Description |
|---|---|---|
| duct_straight | Straight Duct | Rectangular duct section |
| duct_elbow_90 | 90° Elbow | 90-degree rectangular elbow |
| duct_elbow_45 | 45° Elbow | 45-degree rectangular elbow |
| duct_tee | Duct Tee | T-fitting with branch takeoff |
| duct_reducer | Reducer | Transition between duct sizes |
| flex_duct | Flex Duct | Flexible insulated duct |
| damper | Damper | Volume control damper with actuator |
| mixing_box | Mixing Box | OA/RA mixing box |
| diffuser | Diffuser | Square ceiling diffuser |
| grille | Return Grille | Return air grille |

# 4. Piping Components

| Component ID | Name | Description |
|---|---|---|
| pipe_straight_copper | Copper Pipe | Copper pipe section |
| pipe_straight_steel | Steel Pipe | Black steel pipe section |
| pipe_straight_pvc | PVC Pipe | PVC pipe section |
| pipe_elbow_90 | 90° Elbow | 90-degree pipe elbow |
| pipe_tee | Pipe Tee | T-fitting with branch |
| flow_indicator | Flow Indicator | Inline sight glass/flow indicator |

# 5. Valve Components

| Component ID | Name | Description |
|---|---|---|
| valve_ball | Ball Valve | Quarter-turn ball valve |
| valve_butterfly | Butterfly Valve | Wafer-style butterfly valve |
| valve_gate | Gate Valve | Rising stem gate valve |
| valve_globe | Globe Valve | Globe pattern valve |
| valve_control_2way | 2-Way Control Valve | Modulating control valve with actuator |
| valve_control_3way | 3-Way Control Valve | Diverting/mixing valve with actuator |
| valve_check | Check Valve | Swing check valve |

# 6. Equipment Components

| Component ID | Name | Description |
|---|---|---|
| ahu | Air Handling Unit | Built-up AHU with filter, coil, and fan sections |
| rtu | Rooftop Unit | Packaged rooftop HVAC unit |
| vav_box | VAV Box | Variable air volume terminal with reheat |
| fcu | Fan Coil Unit | Vertical fan coil unit |
| boiler | Boiler | Commercial fire-tube boiler |
| chiller | Chiller | Water-cooled centrifugal chiller |
| cooling_tower | Cooling Tower | Induced draft cooling tower |
| pump_small | Pump (Small) | Small inline pump |
| pump_medium | Pump (Medium) | Medium base-mounted pump |
| pump_large | Pump (Large) | Large end-suction pump |
| heat_exchanger | Heat Exchanger | Plate-and-frame heat exchanger |
| expansion_tank | Expansion Tank | Diaphragm expansion tank |

# 7. Sensor Components

| Component ID | Name | Description |
|---|---|---|
| temp_sensor_wall | Wall Temp Sensor | Room temperature sensor |
| temp_sensor_duct | Duct Temp Sensor | Duct insertion temperature sensor |
| temp_sensor_pipe | Pipe Temp Sensor | Immersion temperature sensor |
| humidity_sensor | Humidity Sensor | Wall-mounted humidity sensor |
| co2_sensor | CO2 Sensor | Wall-mounted CO2 sensor with display |
| pressure_sensor_duct | Duct Pressure Sensor | Static pressure transducer |
| pressure_sensor_pipe | Pipe Pressure Gauge | Pressure gauge/transmitter |
| flow_sensor | Flow Sensor | Inline flow meter |
| occupancy_sensor | Occupancy Sensor | PIR motion/occupancy sensor |
| damper_actuator | Damper Actuator | Electric damper actuator |
| valve_actuator | Valve Actuator | Electric valve actuator |

# 8. Room Templates

| Component ID | Name | Description |
|---|---|---|
| room_office | Office | Standard office room (4m x 4m) |
| room_conference | Conference Room | Large conference room (8m x 6m) |
| room_bathroom | Bathroom | Restroom with tile floor |
| room_mechanical | Mechanical Room | Equipment room with concrete floor |
| room_commercial_kitchen | Commercial Kitchen | Commercial kitchen with drains and exhaust |
| room_commercial_laundry | Commercial Laundry | Laundry room with steam/condensate |
| room_natatorium | Natatorium | Indoor pool with dehumidification |
| room_parking_lot | Parking Structure | Parking level with CO monitoring |
| room_stairwell | Stairwell | Multi-floor stairwell with pressurization |
| room_elevator_machine | Elevator Machine Room | Elevator equipment room |
| room_server | Server Room | Data center with raised floor |

# 9. API Reference

The NexusConnect Component Library is accessible via the NexusConnectBridge API. All endpoints are prefixed with `/api/v1/bridge/components`.

| Endpoint | Method | Description |
|----------|--------|-------------|
| `/library` | **GET** | Get library schema (?compressed=true for OpenZL) |
| `/categories` | **GET** | List all component categories |
| `/list` | **GET** | List components with optional filtering |
| `/2d/{category}/{name}` | **GET** | Download 2D SVG (ETag cached, 24h) |
| `/3d/{category}/{name}` | **GET** | Download 3D GLB (ETag cached, 7 days) |
| `/bundle/{format}` | **GET** | Download ZIP bundle (2d, 3d, or all) |
| `/metadata/{category}/{name}` | **GET** | Get component connection point metadata |
| `/stats` | **GET** | Get library statistics |
| `/batch` | **POST** | Batch fetch multiple components (OpenZL) |
| `/compression-stats` | **GET** | View OpenZL compression statistics |

## *Example API Usage*

```
# Get library schema (with ETag caching)
GET /api/v1/bridge/components/library

# Get OpenZL compressed library
GET /api/v1/bridge/components/library?compressed=true

# Download a 3D AHU model (7-day cache)
GET /api/v1/bridge/components/3d/equipment/ahu

# Download all 3D components as ZIP
GET /api/v1/bridge/components/bundle/3d

# Batch fetch multiple components (OpenZL compressed)
POST /api/v1/bridge/components/batch
[{"format":"3d","category":"equipment","name":"ahu"},
{"format":"2d","category":"ductwork","name":"duct_straight"}]
```

## *OpenZL Compression*

The component library uses Meta's OpenZL for format-aware compression, achieving 50-150% better compression than standard zlib for structured data. Features include:

• **ETag Caching** - Returns 304 Not Modified for unchanged assets

• **Cache-Control Headers** - 24h for SVG, 7 days for GLB static assets

- **Batch Loading** - Fetch multiple components in a single request

- **Compressed JSON** - Library schema compressed to ~10% original size

# 10. Connection Points

All components include connection point metadata for seamless joining in the NexusConnect editor. Connection points are stored as Empty objects in the GLB files with custom properties.

## *Connection Point Properties*

| Property | Type | Description |
|---|---|---|
| name | string | Unique identifier (e.g., 'connection_start', 'supply_air') |
| position | vec3 | Location in local coordinates (x, y, z) |
| direction | enum | Facing direction (x+, x-, y+, y-, z+, z-) |
| connection_type | string | Type: wall, duct, pipe, sensor, etc. |
| connection_size | string | Size specification (e.g., '24x12', '2in') |

## *Connection Type Reference*

| Type | Used For | Compatible With |
|---|---|---|
| wall | Wall segments, corners | wall, door, window |
| duct | Rectangular ductwork | duct, damper, diffuser, grille |
| pipe | Piping systems | pipe, valve, equipment |
| sensor | Sensors, actuators | duct, pipe, wall |
| equipment | HVAC equipment | duct, pipe |
| drain | Floor drains | pipe |
| exhaust | Exhaust connections | duct, hood |
| gas | Gas piping | pipe, equipment |